durch den Übergang zu absoluter Äquidistanz und Alternanz vollkommen wiederhergestellt.

NELSON nimmt an, dass sich die Kronblätter der Angiospermen phylogenetisch nicht von grünen Hochblättern ableiten lassen wie der Kelch, sondern dass die Kronblätter nachträglich durch partielles Sterilwerden aus Staubblättern entstanden seien. Wo dennoch Übergangsformen zwischen Kelch und Krone vorkommen, beruhen sie auf einem «Vorgang der Annäherung», auf einer sekundären gestaltlichen Angleichung eines Organes an ein anderes von organophyletisch heterogener Natur.

Der Morphologe betrachtet den «Phänotypus» der Pflanzen in seiner unmittelbar sichtbaren Veränderlichkeit. Der Genetiker schliesst aus seinen Experimenten auf den hinter dem Phänotypus verborgenen «Genotypus». Bei NELSON ist der «Genotypus» verstanden bald als ein erblich fixierter Phänotypus, bald als eine «Reaktionsnorm». Das anschauliche Denken der vergleichenden Morphologie und das entwicklungsphysiologische Denken durchdringen sich, ohne dass ein Ausgleich der beiden Denkformen erreicht wird.

NELSON wagt sich auch an das schwierige Problem der Vererbung erworbener Eigenschaften. Seine Ausführungen beginnen mit dem Satz: «Gesetzmässigkeiten und Parallelentwicklung der Gestaltwandlung stehen im Widerspruch zu allen mit einem ‚Zufallsgeschehen' rechnenden Evolutionstheorien.» Der Referent würde lieber die Schärfe der Gegensätze mildern und fragen: Was für Argumente hat der Morphologe vorzubringen für ein Zusammenwirken zufälliger Mutationen mit gerichteten Wandlungen in der Phylogenie? Zu solcher Fragestellung bringt NELSON wertvolles Material. Seine Arbeit ist der Beachtung der Fachgelehrten zu empfehlen.

O. SCHÜEPP

Informations - Informationen - Informazioni - Notes

STUDIORUM PROGRESSUS

The Influence of Baroreceptor Reflexes on the Reactivity of the Autonomic Nervous System*

By E. GELLHORN**

Although in nerve-muscle preparations changes in the state of activity of an autonomically innervated organ are known to result in fundamental alterations in the action of sympathetic and parasympathetic nerves no systematic attempt seems to have been made to induce changes in autonomic reactivity and balance either via reflexes or by direct alterations in central autonomic structures such as the hypothalamus. Some of the results obtained in the study of reflexly induced autonomic imbalances are summarized in this paper. Their implications for physiology, medicine, and neuropsychiatry will be discussed in a forthcoming monograph[1].

If in very lightly anesthetized cats the blood pressure was altered by the injection of hypotensive and hypertensive drugs (acetylcholine, mecholyl, histamine, and noradrenaline respectively) characteristic changes in the excitability of the autonomic system in general and of the hypothalamus in particular occurred. The fall of the blood pressure was found to be associated with an increased responsiveness of the sympathetic system to direct stimulation of the posterior hypothalamus and to reflex stimuli acting on the sympathetic system. Conversely, the parasympathetic reactivity was increased during the noradrenaline induced rise of the blood pressure[2]. The increased responsiveness of a specific division of the autonomic system was designated as 'tuning'. During the state of sympathetic tuning produced by the injection of hypotensive drugs the autonomic balance was shifted to the sympathetic side as evidenced by the contraction of the sympathetically innervated nictitating membrane and the acceleration of the heart rate. In sensitive animals the hypotension was accompanied also by a contraction of the denervated nictitating membrane signifying a sympathetico-adrenal discharge[3]. On the other hand, the state of parasympathetic tuning was associated with parasympathetic discharges as evidenced by a slowing of the heart rate.

During the state of sympathetic tuning the autonomic nervous system showed not only an increased responsiveness to stimuli acting on the sympathetic system but a diminished responsiveness to parasympathetically acting stimuli.

Corresponding changes occurred in the state of parasympathetic tuning. Thus the sympathetic responsiveness of the hypothalamus as indicated by the height of contraction of the nictitating membrane on stimulation of the posterior hypothalamus was diminished during the state of parasympathetic tuning (i.e. during the rise of the blood pressure following the injection of noradrenaline) whereas the responsiveness to a parasympathetically acting stimulus was enhanced. The latter phenomenon is illustrated by the fact that the stimulation of the sciatic nerve or the hypothalamus with a square wave current of low frequency produced a much greater parasympathetic effect (slowing of the heart rate and/or fall of the blood pressure) in the state of parasympathetic tuning than under control conditions.

The changes in autonomic reactivity described thus far were easily demonstrated with near threshold or subthreshold stimuli. The experiments demonstrated the validity of the law of reciprocal innervation for states of sympathetic and parasympathetic tuning.

That the changes in blood pressure and not a specific drug action were responsible for the effects of 'tuning'

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[1] E. GELLHORN, *Autonomic Imbalance and the Hypothalamus* (University of Minnesota Press, Minneapolis 1957).

[2] Unpublished experiments with E. S. REDGATE.

[3] E. GELLHORN, *Physiological Foundations of Neurology and Psychiatry* (University of Minnesota Press, Minneapolis 1953), p. 471.

was apparent from the observation that a fall of the blood pressure through bleeding and a rise of the blood pressure through the injection of dextran were associated with characteristic alterations in autonomic reactivity. On the basis of these experiments it may be said that a moderate hemorrhage leads to a reversible state of sympathetic tuning whereas the injection of dextran induces a state of parasympathetic tuning[2].

Since variations of the blood pressure regardless of the mechanism involved seemed to lead to characteristic changes in the reactivity of the autonomic nervous system it appeared likely that the barorecepetor reflexes of the sino-aortic area would be involved. This hypothesis was verified by the observation that the characteristic effects of autonomic tuning were greatly diminished or abolished by denervation of the sino-aortic areas. The tuning effects described in this paper are therefore regarded as the result of the action of baroreceptor reflexes on central autonomic structures.

In view of the fact that earlier investigations[4] had demonstrated the decisive influence of the state of excitability of the hypothalamus on the action of acetylcholine, mecholyl and histamine and on the nor-adrenaline-induced reflex slowing of the heart rate it was thought advisable to investigate the action of these drugs and of the baroreceptor reflexes on the hypothalamus. Advantage was taken of the fact that changes in the excitability of the posterior hypothalamus are accompanied by corresponding changes in the intensity of the hypothalamic-cortical discharges influencing the activity in the whole cerebral cortex[5].

Therefore alterations in the electrocorticogram may suggest changes in the intensity of the hypothalamic-cortical discharge related to the state of excitation of the posterior hypothalamus.

Several groups of experiments were performed. In one group the action of hypotensive drugs on the ECG was investigated before and after discrete lesions had been made in the posterior hypothalamus by high frequency currents[6]. These experiments showed that after unilateral hypothalamic lesions the degree of cortical excitation induced by hypotensive drugs was lessened on the ipsilateral side. In the second group, the action of hypo- and hypertensive drugs on the cerebral cortex was investigated before and after sino-aortic denervation[7]. Under control conditions acetylcholine caused an excitation of the cerebral cortex indicated by an increased asynchrony of cortical potentials and an increase in the integrated amplitude of the fast potentials[8]. Noradrenaline, however, caused the opposite effect: the cortical potentials became more synchronized and the integrated amplitude of the potentials was increased for the low frequencies only. The effects of hypo- and hypertensive drugs on the ECG were practically abolished by sino-aortic denervation.

The conclusion drawn from these experiments that baroreceptor reflexes, modified by the changes in the intrasinusal pressure following the injection of acetylcholine and noradrenaline, act on the posterior hypothalamus and thereby alter the hypothalamic-cortical discharge was borne out by a third group of experiments. The action of acetylcholine and noradrenaline was studied on the potentials of the posterior hypothalamus. It was found that acetylcholine caused an excitation of the hypothalamic potentials (increased asynchrony and recruitment) whereas noradrenaline had the opposite effect[9].

In recent years numerous investigators have shown that protoveratrine excites the baroreceptors of the carotid sinus[10]. If the baroreceptor reflexes act not only on the medulla oblongata but also on the hypothalamus (and thereby on the cerebral cortex) as our experiments suggest, one should expect that the hypotensive action of protoveratrin would depend on the state of excitability of the hypothalamus. Experiments were performed, therefore, on the action of protoveratrine (0·0005 mg/kg intravenously) on the blood pressure of cats[9]. The mean fall of the blood pressure in the control group on administration of this drug was 37 mm Hg whereas following reduction of the excitability of the posterior hypothalamus through the intrahypothalamic injection of nembutal or high frequency coagulation of this area the mean fall of the blood pressure was 5·9 mm Hg.

Zusammenfassung

Fallen des Blutdruckes bewirkt sympathische, seine Steigerung hingegen parasympathische «Umstimmung». Erstere ist durch Sympathicotonie und erhöhte Reizbarkeit des sympathischen Systems, letztere durch entsprechende Änderungen des parasympathischen Systems charakterisiert. Diese Änderungen des autonomen Systems resultieren aus den Blutdruckzügler-Reflexen, deren Wirkung sich auch auf den Hypothalamus posterior und von dort auf die gesamte Hirnrinde erstreckt.

[4] E. GELLHORN and E. REDGATE, Arch. int. Pharmacodyn. *102*, 162 (1955). – E. REDGATE and E. GELLHORN, Arch. int. Pharmacodyn. *102*, 179 (1955). – E. GELLHORN, H. NAKAO, and E. REDGATE, J. Physiol. *131*, 402 (1956). – E. REDGATE and E. GELLHORN, Arch. int. Pharmacodyn. *105*, 199 (1956).

[5] E. GELLHORN, *Physiological Foundations of Neurology and Psychiatry* (University of Minnesota Press, Minneapolis 1953); Arch. int. Pharmacodyn. *93*, 434 (1953); EEG Clin. Neurophysiol. *5*, 401 (1953). – W. KOELLA and E. GELLHORN, J. comp. Neurol. *100*, 243 (1954). – E. GELLHORN, Brain *77*, 401 (1954). – W. KOELLA and H. BALLIN, EEG Clin. Neurophysiol. *6*, 629 (1954).

[6] Unpublished experiments wirh E. B. SIGG.

[7] H. NAKAO, H. M. BALLIN, and E. GELLHORN, EEG Clin. Neurophysiol. *8*, 413 (1956).

[8] In these experiments the ECG was studied with an Offner frequency analyser.

[9] Unpublished experiments with H. M. BALLIN.

[10] L. CALLIAUW, Arch. int. Pharmacodyn. *107*, 75 (1956). – S. C. WANG, S. H. NGAI, and R. G. GROSSMAN, J. Pharmacol. exp. Therap. *113*, 100 (1955). – G. MATTON, Arch. int. Pharmacodyn. *103*, 13 (1955).

Corrigenda

H. BÄCHTOLD und A. PLETSCHER: *Einfluss von Isonikotinsäurehydraziden auf den Verlauf der Körpertemperatur nach Reserpin, Monoaminen und Chlorpromazin*, Experientia, vol. XIII, Heft Nr. 4, S. 163 (1957).

Auf Seite 163, 11. Zeile von oben, soll es richtig heissen «*Rimifon*» (anstatt Rimiform).

MARIA SZÉKELY: *Die Bedeutung der Mitochondrienstruktur für die Zitronensäuresynthese*, Exper. *13*, Heft Nr. 1, 24 (1957).

Auf Seite 25, linke Kolonne, nach der Tabelle III muss es richtig heissen: «Dabei konnte die Hemmung durch höhere Konzentrationen der an der Reaktion beteiligten Substrate und Coenzyme *nicht* aufgehoben werden» (anstatt aufgehoben werden).
